PC-1 SCHEME

Survey of Wild Bee Pollinators from Coniferous Forests of Khyber Pakhtunkhwa

ADP NO: 542
SCHEME CODE: 220068

(Total cost Rs. 15.000)

(Duration: July 2022 to June 2025)

PAKISTAN FOREST INSTITUTE PESHAWAR
FORESTRY, ENVIRONMENT & WILDLIFE DEPARTMENT
GOVERNMENT OF KHYBER PAKHTUNKHWA
2022

GOVERNMENT OF KHYBER PAKHTUNKHWA
FORESTRY, ENVIRONMENT & WILDLIFE DEPARTMENT

1. Name of the project: Survey of Wild Bee Pollinators from Coniferous Forests of Khyber Pakhtunkhwa.

2. Location: Throughout Khyber Pakhtunkhwa

3. Authorities responsible for:

i. **Sponsoring**: Forestry, Environment & Wildlife Department, Government of Khyber Pakhtunkhwa.

ii. **Execution**: Pakistan Forest Institute, Peshawar

iii. **Operation and maintenance**: Pakistan Forest Institute, Peshawar

iv. **Concerned Federal Ministry**: N.A

4. Plan provision:

The project is included in Khyber Pakhtunkhwa ADP.2022-23 under serial No. 542 with code 220068. Project period is three years and the date of completion of the project is 30.06.2025.

5. Project objectives and its relationship with sector objectives

A pollinator is an animal that moves pollen from the male anther of a flower to the female stigma of a flower. This helps to bring about fertilization of the ovules in the flower by the male gametes from the pollen grains. Approximately, 80 percent of all flowering plants species are pollinated by animals, including vertebrates and mammals but the main pollinators are insects and among insects, bees are most efficient pollinators. Pollinators are responsible for providing with a wide variety of orchard, agricultural crops, horticultural crops, forage production as well as forest trees. More than three quarters of the world's food crops rely at least on some parts on pollination by insects and other animals.

Pollinators contribute to the maintenance of biodiversity, and ensure the survival of plant species including plants that provide food security to innumerable rural households. Pollination is an essential ecosystem service, as it enables plant reproduction and food production for humans and animals (fruits and seeds) that depend, to a large extent, on the symbiosis between species, i.e., the pollinated and the pollinator. The reduction and/or loss of either will affect the survival of both.

Pollination is an ecosystem service that is key to food security. Pollinators are essential for many fruit and vegetable crops. In agriculture, especially amongst pollen-limited crops, promoting pollination services is a means of increasing productivity without resorting to expensive agricultural inputs of pesticides or herbicides. Over and above its direct economic value to humans, pollination by animals provides essential maintenance of the structure and function of a wide range of natural communities, and it enhances aesthetic, recreational, and cultural aspects of human activity. Natural ecosystems and many agricultural ones depend on pollinator diversity to maintain overall biological diversity.

Bees and trees belong together. Given the choice, wild honey bees chose nesting places in trees rather than in an open landscape, and they prefer to nest high in trees (more than three meters above ground) instead of close to the ground, as beekeepers' hives are kept. Most bumblebees nest underground, except for the tree bumblebee, which as recently arrived from Europe. When enough bees are present in a forest, they provide a better pollination that leads to improved regeneration of trees and conservation of the forest's biodiversity.

In view of that economic and ecological importance, there is a need to identify wild bee species from Coniferous Forests of Khyber Pakhtunkhwa for which there is evidence of decline, analyzes the putative causes of those declines, and discusses their potential consequences, need of monitoring, conservation and their restoration.

Project objectives

The specific objectives are to:

1. To collect Wild Bee Pollinators from Coniferous Forests of Khyber Pakhtunkhwa.

2. To identify and document the bee species at family, genus and species level for reference purpose.

3. Dissemination of scientific knowledge to different stakeholders.

6. Description, justification, technical parameters and technology transfer aspects

Description

Pollination is most important reproductive process without which plants normally do not produce fruits and never any fertile seeds. Wild bees pollinate 87% of flowering plants and ensure 35% of the global food supply by pollinating 75% of global food. Pollinators contribute directly to food security. Nearly three quarters of the plants that produce 90 per cent of the world's food require this external help. According to bee experts at the Food and Agriculture Organization, a third of the

world's food production depends on bees. Entomophily is by far the most common mean of pollen transfer and it played a vital role in the evolution of angiosperms. There are about 250000 species of flowering plants globally which are pollinated by 200000 species of animals. Out of 95 percent of the flower which are cross pollinated, more than 85 percent depend on insects for pollination. Insect pollinators include honey bees, bumble bees, pollen wasps, ants, flies including bee flies, hoverflies, butterflies and moths and flower beetles. 50 percent of the plant species propagated by seeds are dependent on insect pollination whereas one third of the food supply is either directly or indirectly depend on these insects pollinated plants.

Justification

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The principle pollinators are bees. Approximately 73% of the world's cultivated crops, such as cashews, squash, mangoes, cocoa, cranberries and blueberries, are pollinated by some variety of bees, 19% by flies, 6.5% by bats, 5% by wasps, 5% by beetles, 4% by birds, and 4% by butterflies and moths[1]. Of the hundred principal crops that make up most of the world's food supply, only 15% are pollinated by domestic bees (mostly honey bees, bumble bees and alfalfa leafcutter bees), while at least 80% are pollinated by wild bees and other wildlife (as there are an estimated 25,000 bee species, the total number of pollinators probably exceeds 40,000 species). Services that are provided by native pollinators (non-honeybee species) are estimated to be worth US$ 4.1 billion a year to United States agriculture alone[2]. The value of the annual global contribution of pollinators to the major pollinator-dependant crops is estimated to exceed US$ 54 billion.

Pollinator decline will have serious socio-economic consequences for countries like Pakistan, which host a large population of small and marginal farms for whom falling yield level would be critical for subsistence. Pollinating insects are in decline worldwide resulting in pollination crisis, for (food) crops as well as wild plants and loss of natural biodiversity. Possible drivers for the decline of insect pollinators include habitat loss, intensive land use, globalization and introductions of foreign species, pollution including pesticides, worldwide presence of the invasive parasitic mite Varroa destructor, introduction and spread of new parasites, loss of the honeybee's genetic diversity, and detrimental beekeeping practices and climate change. This demands a response from land managers, conservationists and political decision makers to the impending 'global pollinator crisis'. Understanding the causes of pollination failure in plants can aid the successful conservation and recovery of rare plants, maintenance of crop yields, and sustainable use of wild plant resources such as forest timber.

According to an estimate the world production value for crops used for human food was €1618 trillion, and the total value of the 46 insect pollinated direct crops was €625 billion, that is 39% of the world production value during 2005. The economic value of insect pollination was €153 billion. The rate of vulnerability of the world agricultural production used for human food in the face of

total pollinator loss was 9.5%. Furthermore, some regions are specialized in the production of some pollinator-dependent crop category; the vulnerability of the world production for these categories is much higher than the overall worldwide value. The decline in pollinator population and diversity presents a serious threat to agricultural production and conservation and maintenance of biodiversity in many parts of the country. One indicator of the decline in natural insect pollinators is decreasing crop yields and quality despite necessary agronomic inputs.

Technical parameters

1. **Survey and Collection**

Survey will be conducted from different locations of Conifer forests of Khyber Pakhtunkhwa. The representative districts of Conifer forests are Lower Chitral, Upper and Lower Dir, Swat, Shangla, Battagram, Kohistan, Mansehra, Abbottabad, Malakand and Bajur. The bee specimens will be collected with the help of Insect Net, Malaise Traps and Bowl Traps.

2. **Specimen Preservation**

The collected specimens will be killed in plastic bottle having ethyle acetate, into the bottom of which absorbing paper will be set to absorb the killing fluid. The freshly collected specimens will be preserved in a 50 ml collecting bottle containing 70% alcohol with a label.

3. **Mounting and Labeling**

Specimens will be pinned by two methods. Small sized specimens will be mounted on a white card whereas large specimens will be pinned directly between tegula and the middle of thorax towards right side. Every specimen will be labeled with complete information.

4. **Identification**

The preserved specimens will be identified under microscope through different morphological characters. Identification will be made with the help of available taxonomic keys The Fauna of British India, by C. T. Bingham, (1897), The Bees of the World C. D. Michener, (2007). Additionally specimens will be identified by comparison with already identified specimens at Pakistan Museum of Natural History (PMNH), National, Insect Museum NARC, Islamabad and any other laboratory of Pakistan with native bee specimens.

5. **Description**

Morphological terminology will be followed with that of Michener (2007), Bingham (1897) and Eardley *et al.,* (2010).

6. **Illustrations and Photographs**

External morphology will be observed using the Stereomicroscope and will be photographed with a Nikon DS-Fi2 digital camera.

Project outputs

The main outputs of the project include the following:

1. Baseline information from the project will enhance the capacity of conservation initiatives to incorporate these important and neglected ecosystem components into conservation planning and ecological monitoring programmes, and will ensure the sustainability of pollination services in future.
2. Properly curated and preserved wild bee fauna of Khyber Pakhtunkhwa will be established.
3. Dissemination of scientific knowledge to Foresters, Agriculturist, Wildlife specialist, Researchers, farmers and other stakeholders.
4. Publication of research papers, technical reports pamphlets and brochures.

1. Capital cost estimates

- Date of estimation of project cost: June, 2022
- Local Cost: Rs. 15.000 Million
- Foreign exchange: Nil
- Total: Rs. 15.000 Million

Year wise / item wise break up of physical and financial phasing

(Rs. Millions)

S. No.	Activity	2022-23	2023-24	2024-25	Total
1	Molecular studies/DNA barcoding	0.150	0.200	0.200	**0.550**
2	Purchase of Bee Traps & collection boxes	0.100	0.150	0.150	**0.400**
3	Printing of research &extension material	0.050	0.050	0.150	**0.250**
4	Inputs (survey kits/tools/Pesticides etc.)	0.150	0.200	0.150	**0.500**
5	Purchase of Consumable research items	0.200	0.200	0.115	**0.515**
6	Training workshop	-	-	0.350	**0.350**
7	Repair & Maintenance of Research Equipments	0.200	0.250	0.100	**0.550**
8	Field survey cost	2.100	2.425	2.530	**7.055**
9	Paid Internee	0.550	0.600	0.750	**1.900**
10	Stationary	0.050	0.060	0.060	**0.170**
11	Salary of DPL (Skilled & unskilled)	0.480	0.550	0.500	**1.530**
12	Miscellaneous	0.380	0.400	0.450	**1.230**
	Total	**4.410**	**5.085**	**5.505**	**15.000**

Note: The unit cost estimates are based on prevailing market rates which can be increased or decreased with the passage of time.

Year wise/ component wise physical activities

S. No	Items	Unit	2022-23	2023-24	2024-25	Total
1	Collection of Wild bee pollinators specimens	No.	500	500	500	1500
2	Preservations of specimens	No.	200	200	200	600
3	Species identification	No.	50	100	100	250
4	Publication of research material	No.	-	02	02	04
5	Training workshop	No.	-	-	01	01

2. Annual operating and maintenance cost after completion of the project

N/A

9. Demand and supply analysis

N/A

10. Financial plan and mode of financing

The project will be financed by Forestry, Environment & Wildlife Department, Government of Khyber Pakhtunkhwa.

i) Equity: Rs. 15.000 Million

ii) Debt: Nil

iii) Grants: Nil

iv) Weighted cost of capital: Nil

11. Project benefits and analysis:

I & ii. Financial and Economic

- Pakistan Forest Institute, Peshawar will work as technology transfer center which will not only deliver fruitful findings to the farmers but will also conduct field trials.

iii. Social benefits with indicators

- Increase of farmers income through increase of pollination services by wild bee pollinators
- Awareness among the farmers community for conservation of bee pollinators
- Forward and backward economic linkages

iv. Employment generation (direct and indirect)

Employment will be generated through:

- Direct employment generation through skilled and unskilled workers
- Creation of viable and self-governing farmers' organizations, employment generation.
- Increase demand of good quality wood will generate employment opportunity in agro forestry sector as well as in wood based industries.

v. Environmental impact:

- The base line study will be helpful in sustaining the ecosystem and produce quality timber.

vi. Impact of delays on project cost and viability

The anticipated risks may comprise

- Delay in release of funds
- Delay in employment of project staff
- Inflation hike may hamper the future project activities

12. a) Implementation schedule

3 year (36 months from the date of commencement)

S.#	Activities	1st Year	2nd Year	3rd year
1	Purchase of machinery, equipments and other research materials			
2	Reconnaissance Surveys			
3	Preservation of specimens			
4	Identification of specimens			
5	Labeling and images of specimens			
6	Brochures /leaflets, Project report writing and publicity of the achievements through magazines, scientific journals and mass media.			

12. b. Result based Monitoring (RBM) Indicators

Input	**Output**	**Outcomes**		**Targeted Impacts**
		Baseline indicator	**Target after project completion**	
Reconnaissance Surveys	Base line data will be compiled for future pollinator conservation strategies	Enhanced and standardised "current status and monitoring" tools and techniques	-	Improved understanding of management practices that contribute to the conservation/restoration of pollinator diversity
To compile distributional information on wild bee pollinators	Increase in fuel wood and timber wood production	Share experiences and disseminate results of the project related to the conservation and sustainable use of pollinators	-	Increase in biodiversity result in increase of fuel wood and timber wood production.
identification of habitat management practices that promote/conserve pollinator diversity	establishing forest refugia, managing succession stages of host plants preferred by pollinators, planting pollinator friendly species on borderlands	Enhanced conservation and sustainable use of forest trees.	-	Increase socio-economic benefits of tree growers.
Sharing of Experiences and Dissemination of Results	Enhanced research capacity for conservation of bee pollinators	Dissemination of scientific knowledge to researchers, teachers and policy makers.	-	Improvement in existing scientific knowledge at national level

13. Management structure and man power requirements including specialized skills during construction and operational phases

The project shall be executed under the overall supervision and guidance of Director General PFI, Peshawar. The Project In charge/Principal Investigator of the project will carry out the project's operation and maintenance. The project activities will be managed by Director (NTFP) as Principal Investigator. Monitoring and evaluation of the project will be carried out by the M&E Committee constituted by the DG, PFI. The research findings/results will be transferred to grower's community through Provincial Forest departments, Extension workers and all other means of communication like, newspapers, bulletins, and demonstration trial etc.

14. Additional projects/decisions required to maximize socio-economic benefits from the proposed project:

N.A

15. It is certified that the project proposal has been prepared in the light of instructions provided by the Planning Commission for the preparation of PC-1 for Environment sector.

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Annex-1

Cost Estimates of Training Workshop

For 30 participants

S.#	Items	Cost
1	Lecture Fee for resource person @ Rs.2500/- per lecture	0.020
2	Food (two teas with refreshment and lunch)	0.080
3	Training Material	0.070
4	Coordination charges	0.035
5	Supporting staff	0.015
6	Logistic support for trainees	0.030
7	Accommodation	0.060
8	Miscellaneous	0.040
	Total	**0.350**

Annex-II

Qualification and Job description of Internee

S. No.	Qualification	Job description
1.	At least B.Sc (Hons) in Agriculture	• Insect setting • Insect preservation • Insect identification • Collection of data • Any other task assigned by P.I